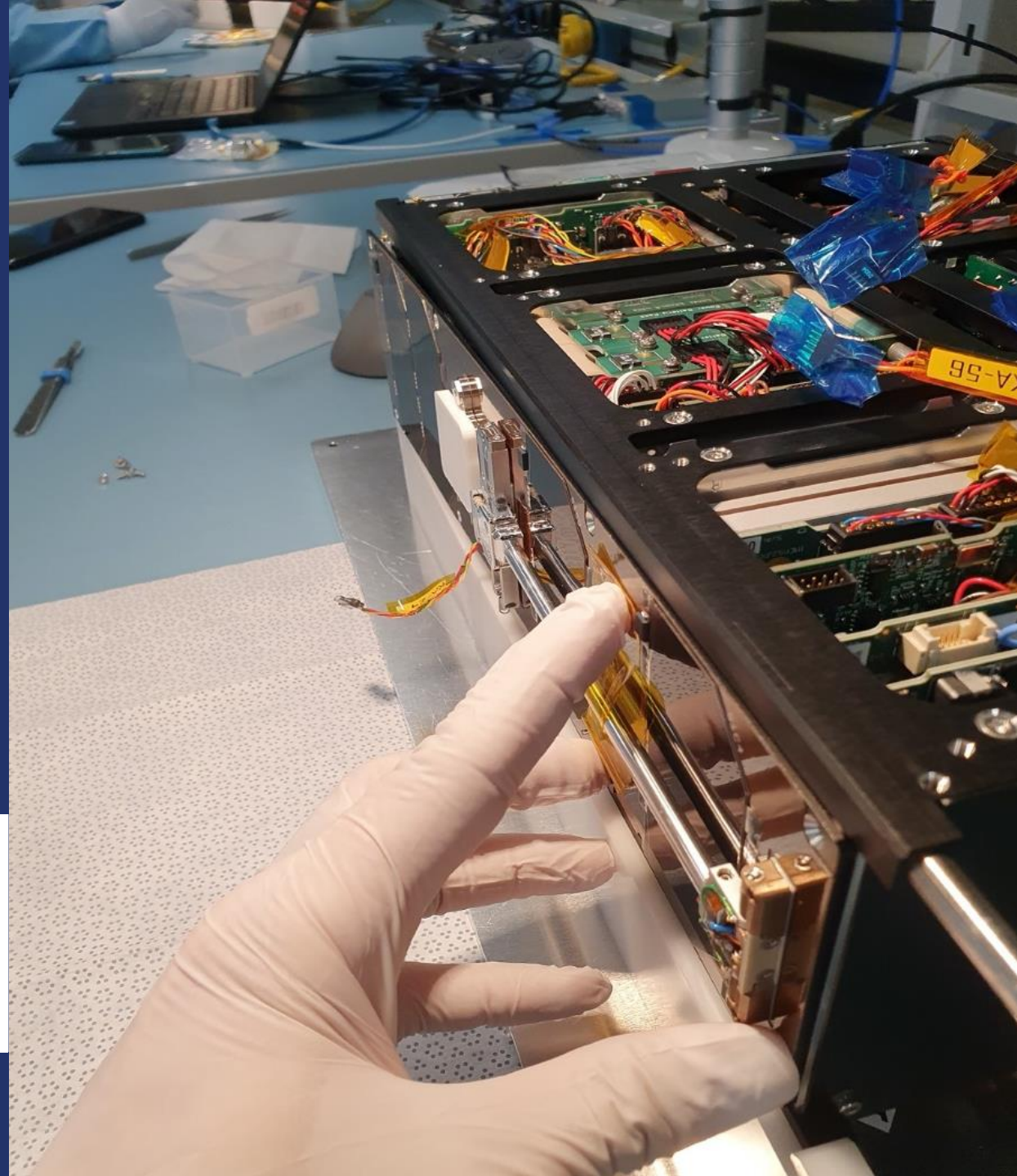
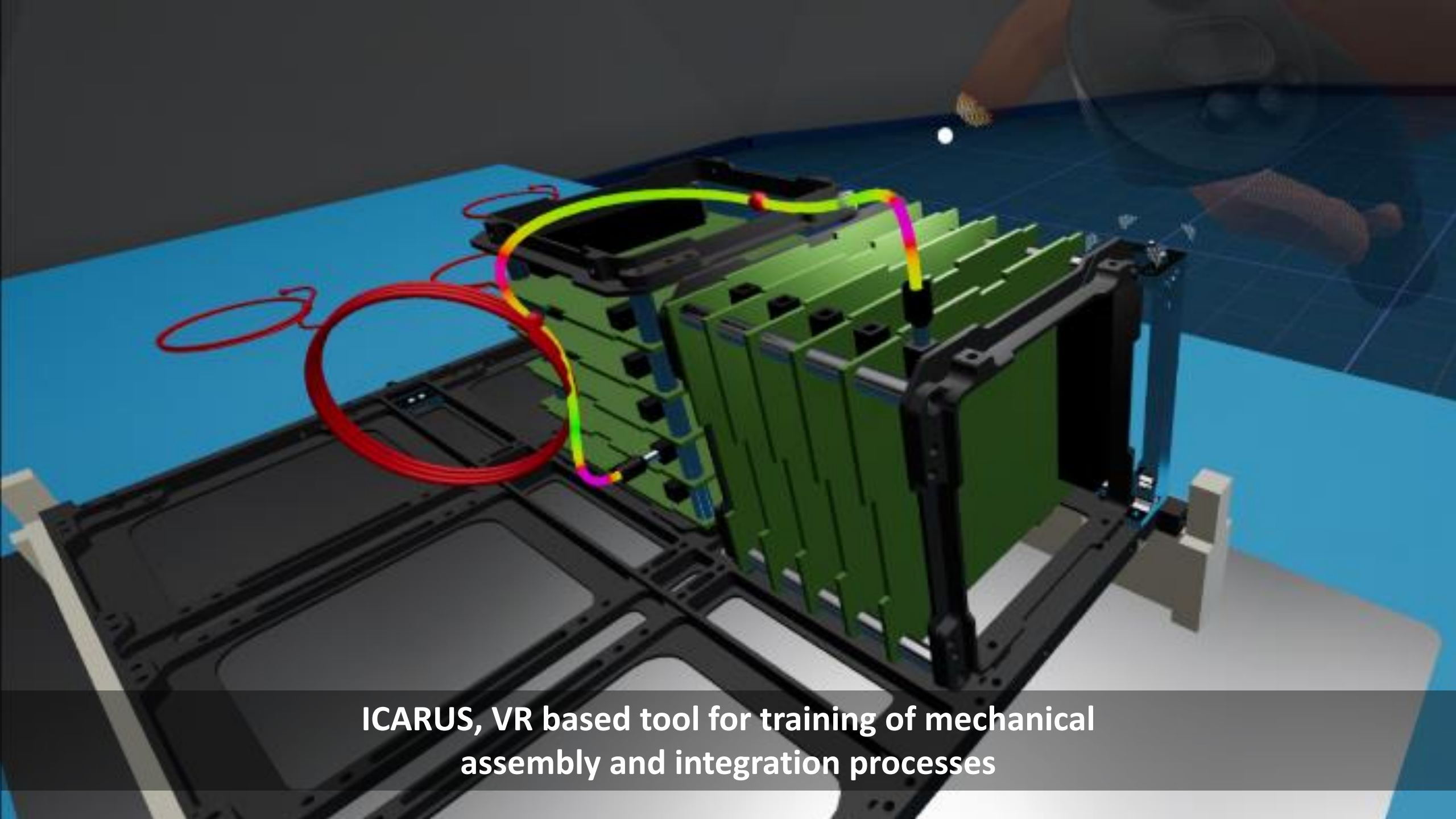
ICARUS

Towards a VR-based training platform for Assembly, Integration and Testing

Emiel den Exter



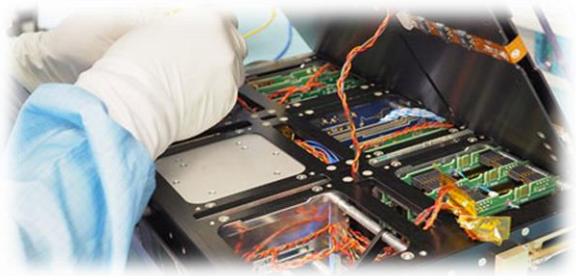
Satellite Assembly, Integration and Testing (AIT) in practise

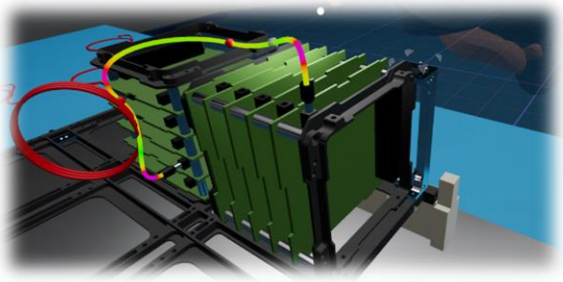


ICARUS, VR based tool for training of mechanical assembly and integration processes

ICARUS VALUE PROPOSITION

ID	Job to be done	Current Method	ICARUS value proposition
1	Training for assembly procedures	Use of actual hardware, where the actual moment of training is predefined and fixed in relation to the hardware manufacturing	Virtual training will provide more flexibility in the timing of the training and lower cost by not using actual physical flight hardware for training purposes.
2	Knowledge retention of procedures	Knowledge retention of recurring operations using written guidelines and best practices	Increased knowledge retention of the recurring operations through by virtual training of guidelines and best practices.
3	Support integration of the satellite(s) into the launcher	Employees are asked to work at the launch site for several days or weeks	Training of launcher integration using a virtual representation of the satellite, to be carried out remotely in a collaborative digital environment.






nlr
ATG
europe
accelerating innovation
ISISPACE
NOTICE
CLEANROOM
STOP!
NO FOOD OR DRINKS BEYOND THIS POINT
LAB COATS
HAIRNETS
GLOVES

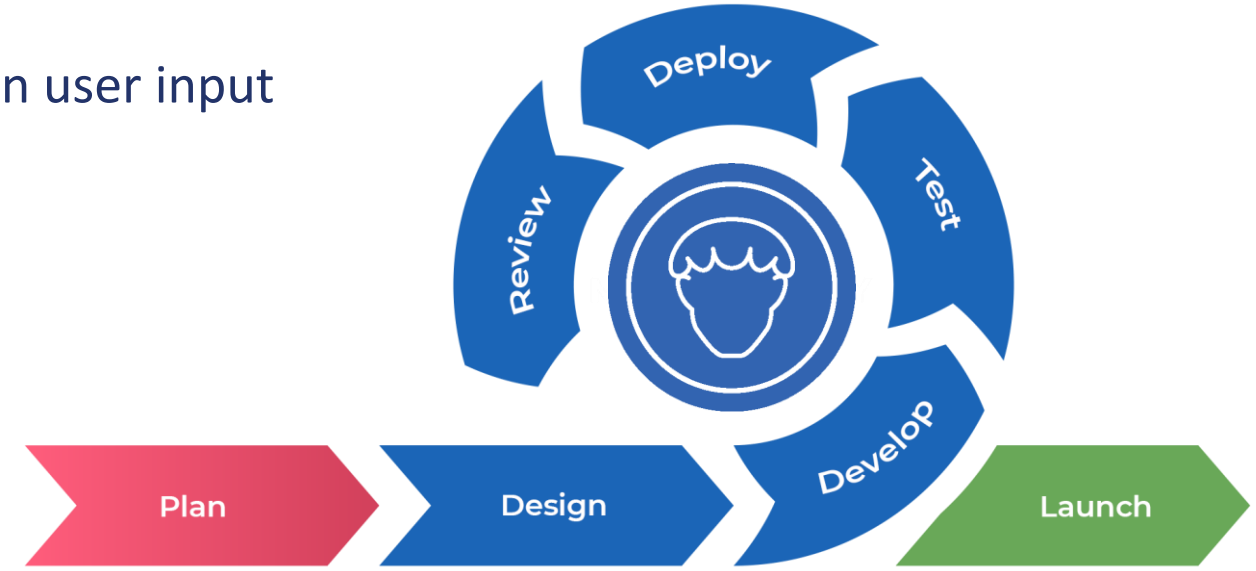
Demo Video

Developing ICARUS MVP as part of an ongoing GSTP project (July 2023 – September 2024)

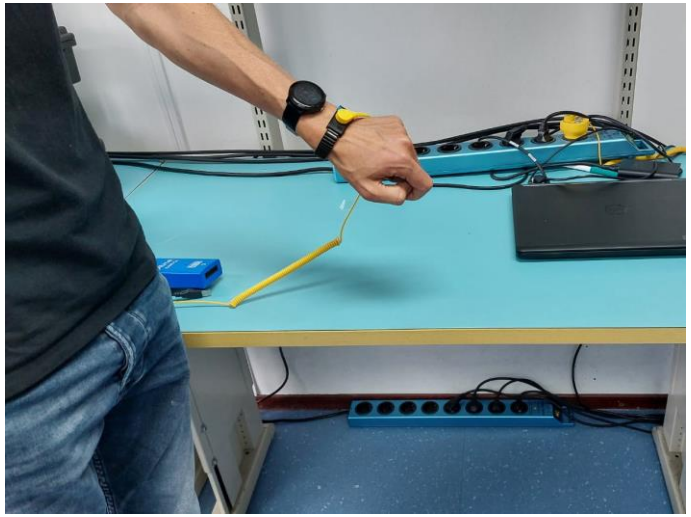
PUTTING INTO PRACTISE

Key steps required to develop a VR tool which will be used in practise:

1. Central focus on the users and their needs
2. Good UX/UI at the core of the project
3. Iterative development, adaptive based on user input and feedback

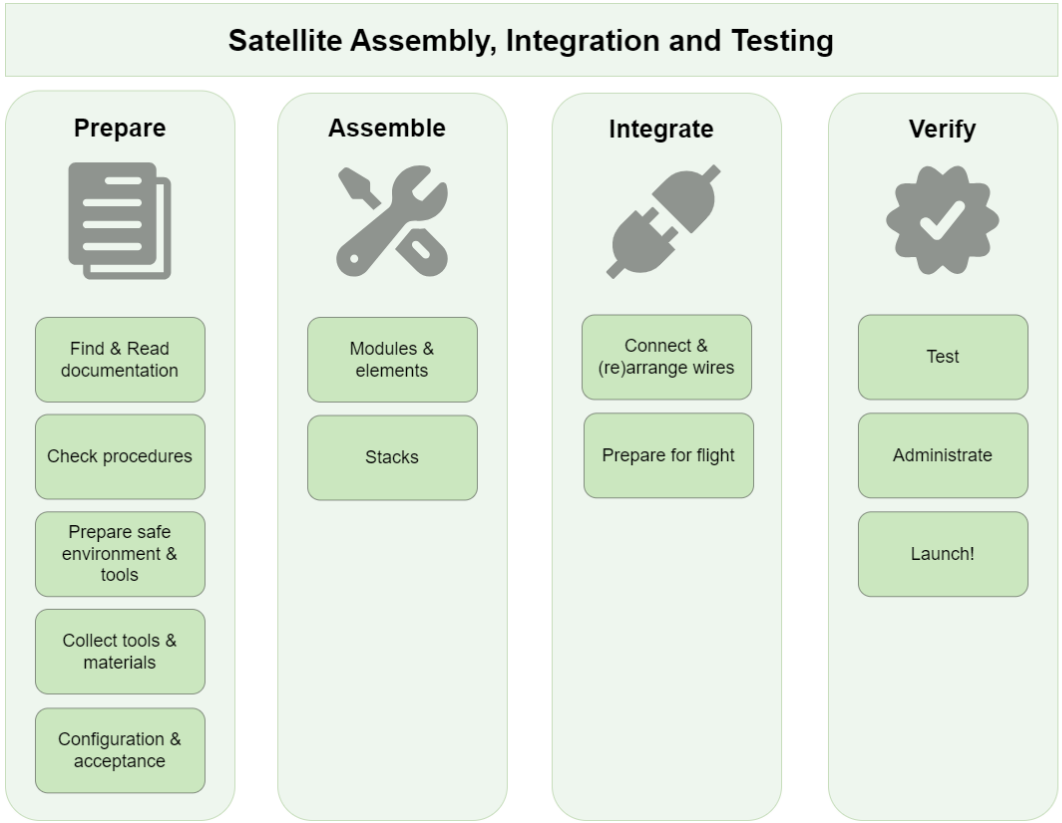


TRAINING DESIGN



ICARUS requirements strongly based on input from ISISpace

TRAINING DESIGN



Operational competence profile for ISISpace AIT engineering based on Training Needs Analysis (TNA)

Knowledge
- System knowledge
- Safety equipment

Skills
- Tooling skills
- Procedural skills
- Spatial awareness

Attitude
- Responsibility
- Safety awareness
- Precise
- Proactive communication

TRAINING DESIGN

Phases	Steps in scenario
Documentation	
Find & read documentation	• Show documentation: simplified steps are displayed on a laptop screen. • A complete documentation package is available, there is no need to check this documentation in this scenario.
Build/check procedure(s)	N.A.
Preparation	
Prepare safe environment and tools	Before the cleanroom: • The trainee will have to select a lab coat, beard, hair and shoe covers in the right order (from top to bottom). • The trainee will have to clean their own laptop with an air syringe. • Attach wrist strap.
Collect tools & materials	In the cleanroom: • Collect screwdrivers, torque tools, epoxy application and tweezers from storage.
Configuration & acceptance	Check if all required materials for assembly and integration are present.
Assemble	
Modules & elements	Assemble a battery pack.
Stacks	Assemble a power stack.
Integrate	
Segments	• Mount the power stack on the 6U structure. • All other stacks are already placed on the structure.
Connect & (re)arrange wires	• Connect the power stack to connectors on other stacks, and (re)arrange the wiring such that cables are as short as possible.
Space System	Mount side frames.

Training scenario excerpt

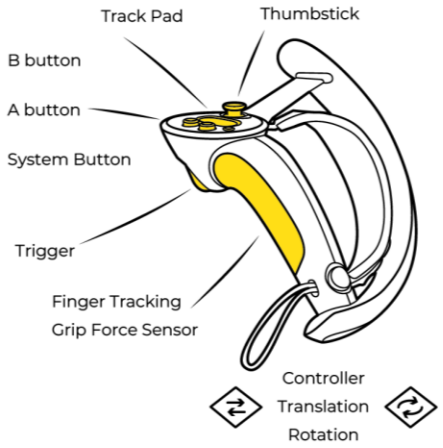
UX/UI DESIGN

Our approach to UX/UI design for VR applications:

1. Based on requirements training scenario
2. Holistic approach, while keeping things as simple
3. Design runs slightly ahead but often parallel to development
4. Separate UX/UI from software implementation, but not too much
5. Lots of trial and error

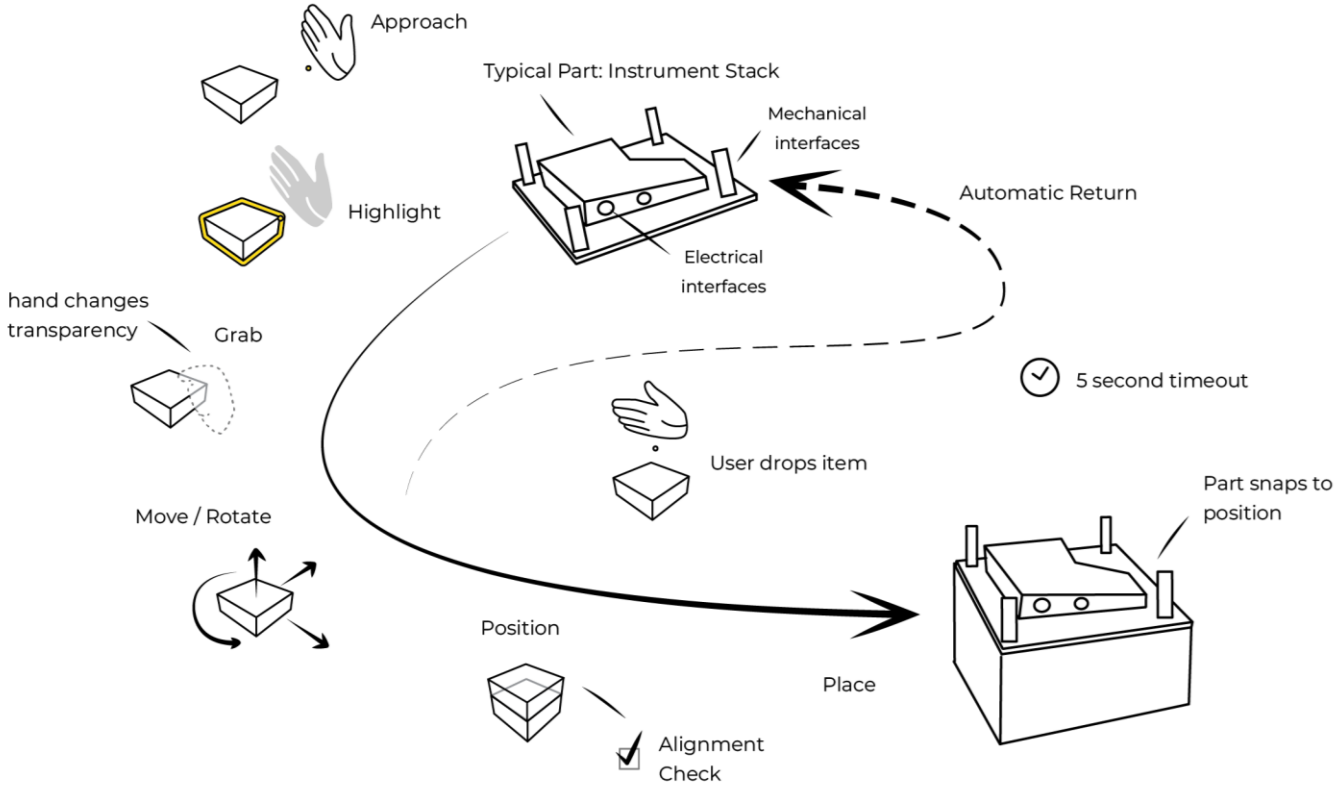
UX/UI DESIGN EXAMPLES

Controller Input Fundamentals



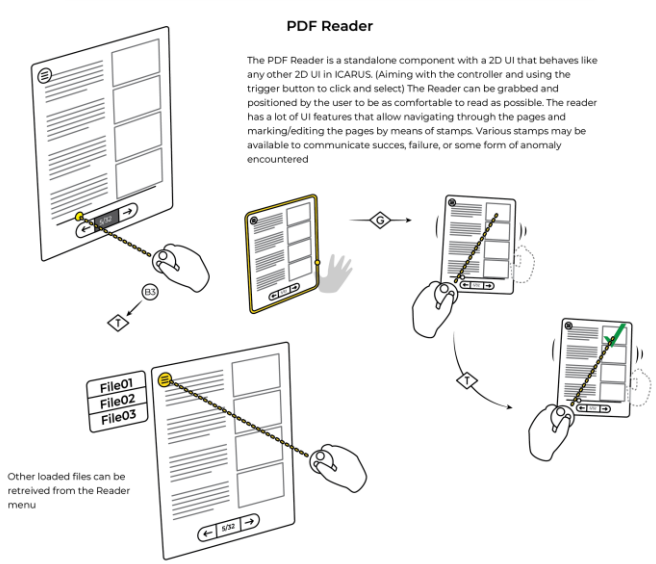
- Grab - Manipulate objects
- Trigger - Main (Positive) Action
- B Button - Secondary (Negative) Action
- A Button - Menu / Identify - Inspect
- Control Stick - Locomotion
- Scroll - Scrolling

Part interaction and manipulation

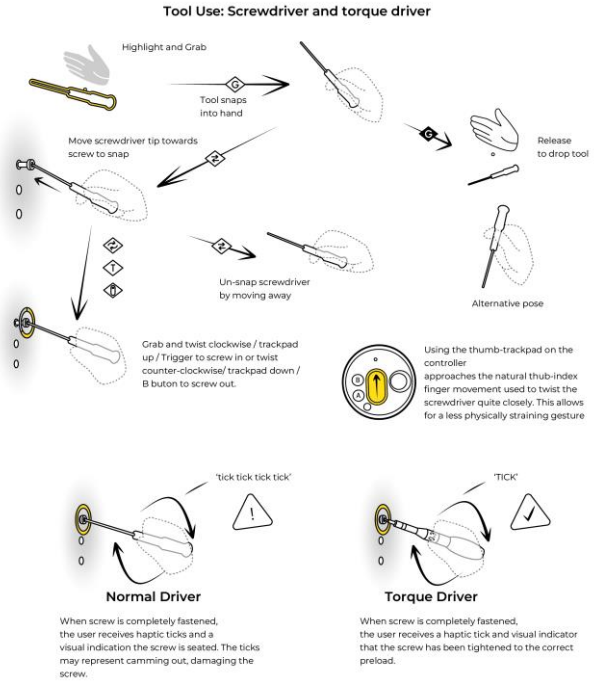


UX/UI DESIGN EXAMPLES

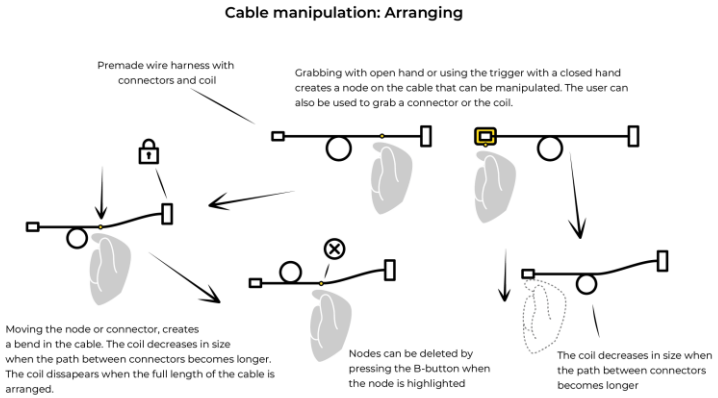
General functionality



Tools

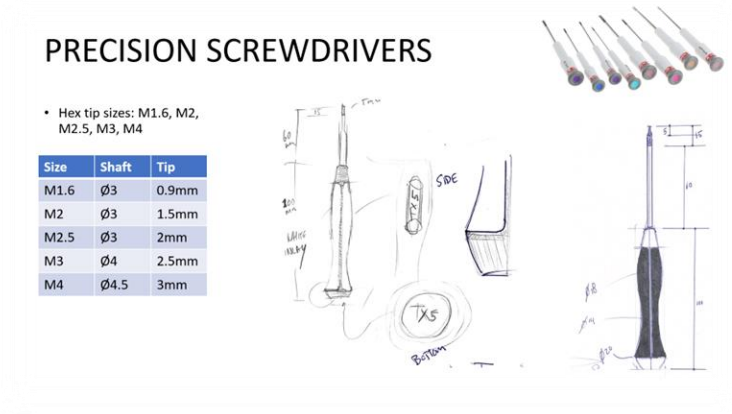


Cables



VISUAL DESIGN

Exploration

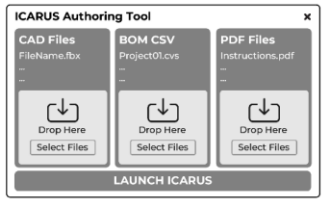


Design

Model

AUTHORING

Enabling trainers to create their own training scenarios in VR

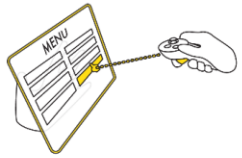


Desktop

Export STEP from CAD software
Export BOM from CAD software
- Fasteners (Type, Size, Thread length)
- Wires (Length, Gauge, Connectors)

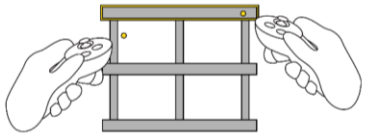
Load model into ICARUS
Load PDF into ICARUS
Load BOM into ICARUS
Start ICARUS

Put on VR Headset



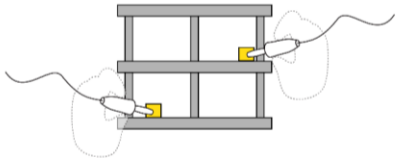
Choose VR environment

Navigate to Model /
Generate model in environment



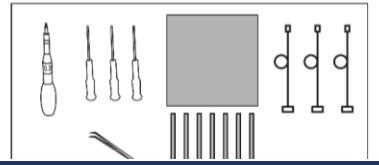
Setup / Interact with model for training

Define the assembly procedure (possibly in reverse order)
Define fasteners (if automation is not implemented).



Setup Wires

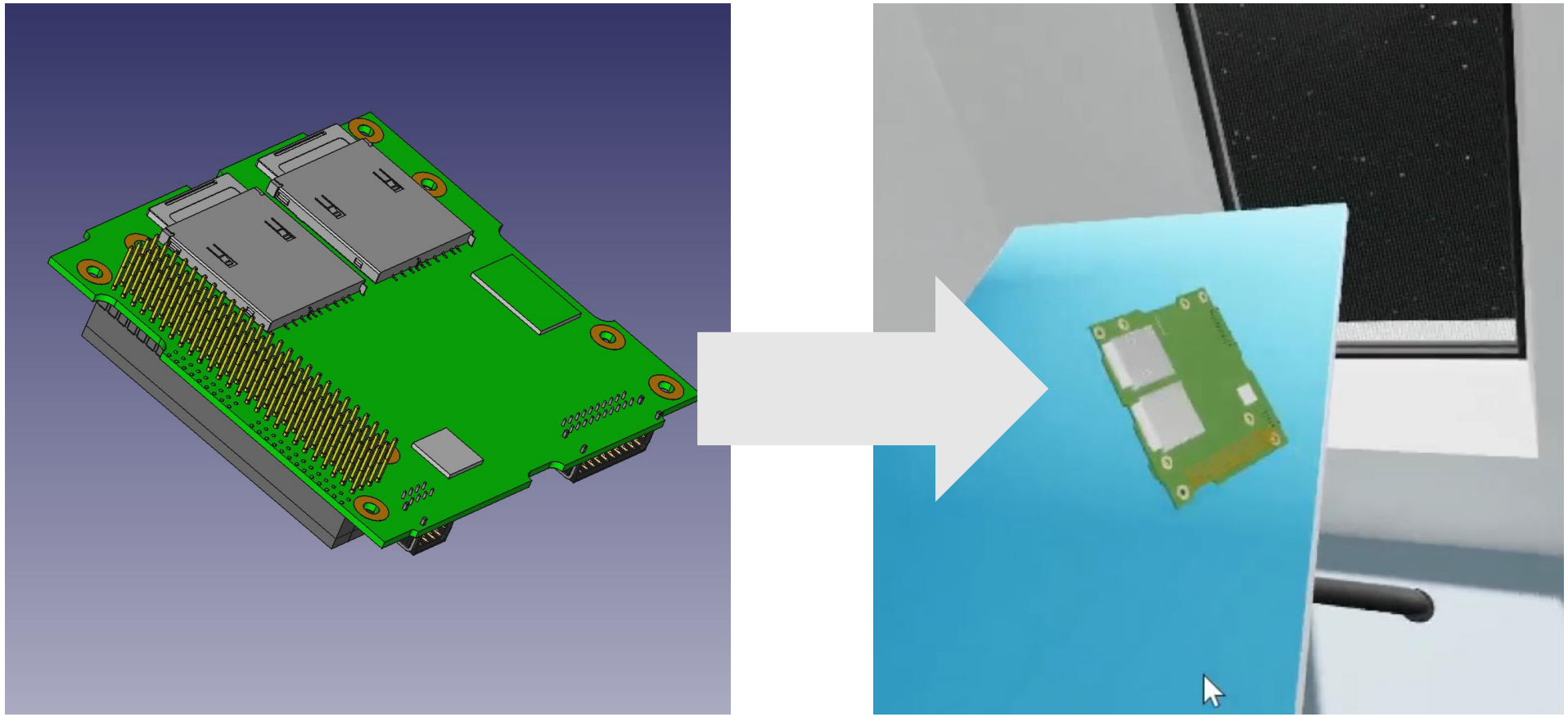
Place connectors and route wires (wires can be undefined length for this step, and fixed length once the trainer is happy with the routing.



Prepare Worksite

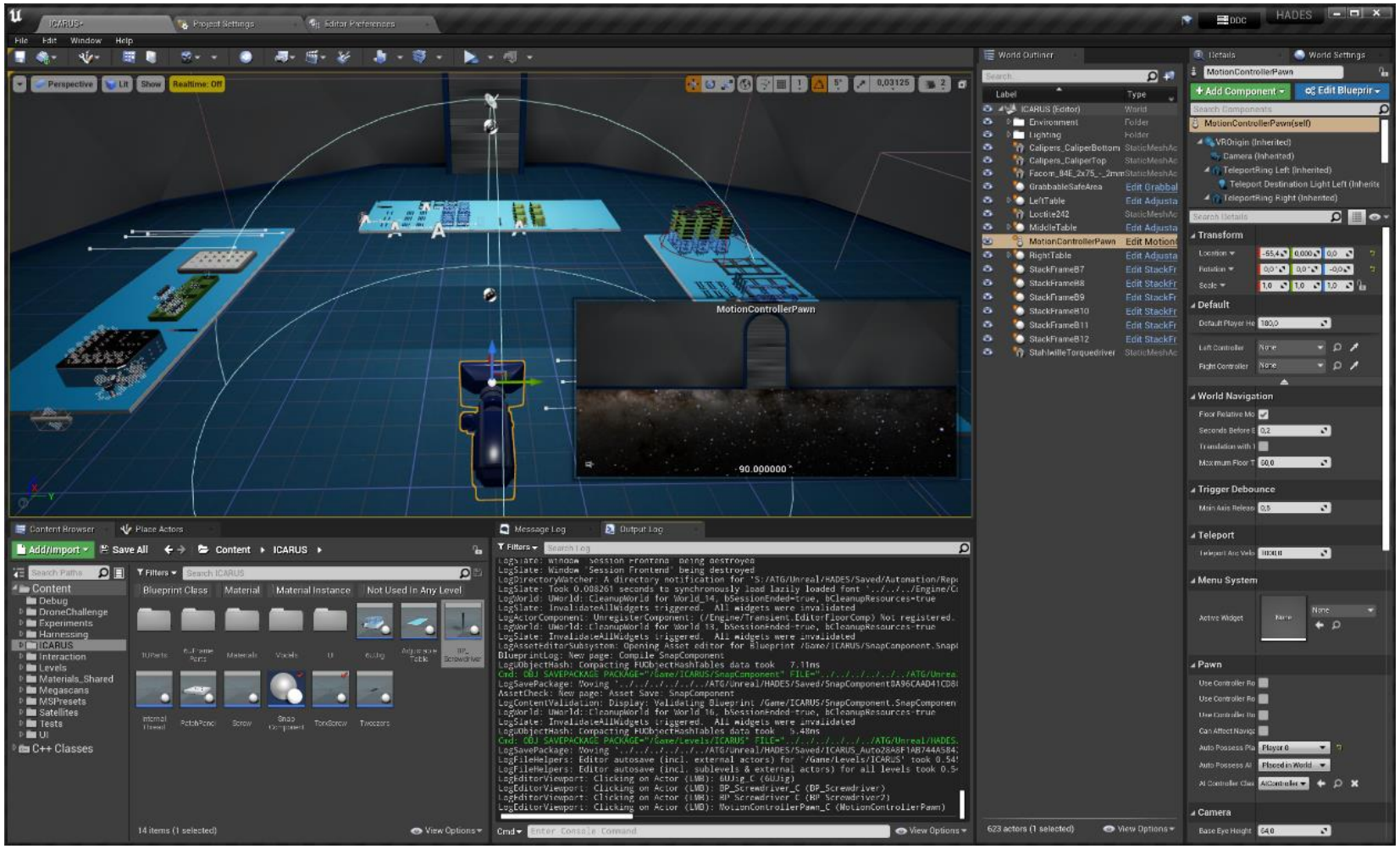
Place components, tools and fasteners on table as needed at the start of the training
Set PDF viewer to the right page
Save Layout / Training
Exit VR

AUTHORING



Importing models from STEP files

IMPLEMENTATION



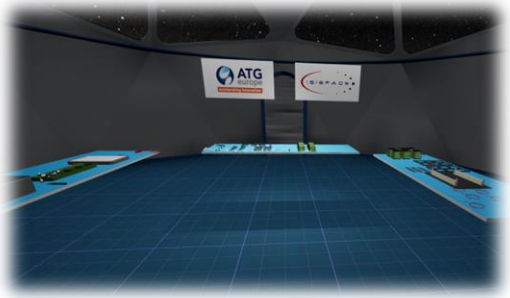
SCHEDULE

2022: Derisk

July 2023: GSTP start

Dec 2023: ESA AR/VR workshop

Sep 2024: MVP release



See you in the demo booth!